Polycrystalline boron-doped diamond films as supports for methanol oxidation electrocatalysts

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Various studies have been done on the development of catalysts for direct methanol fuel cells.[i,ii] Various composite systems has been studied[iii],[iv],[v]. Electrocatalysts with nano-particles have been found to have high activity, which was found to depend on the particle size, the nature of the support as well as the method of preparation.[vi]

Boron-doped diamond films exhibit very high stability both chemical and electrochemically treatments. Other advantages of diamond over other carbon materials are a potential window of approximately three volts, and at least an order of magnitude lower background current, compared to glassy carbon. Some of these same advantages make it an excellent candidate as an analytical electrode for the examination of noble metal alloys catalyst. This excellent stability provides a rationale for the control of the bonding between the metal nanoparticles and the diamond surface. Nanoparticulate diamond may be attractive as an electrocatalyst support for fuel cells.

The electrochemical behavior of boron doped diamond (BDD) films was examined in 0.5 M H_2SO_4 using cyclic voltammetry. The morphology of low-quality diamond (LQD), high-quality diamond (HQD) and polished diamond films has studied using SEM. The boron doped diamond films were characterized using SEM/EDS, X ray diffraction analysis, XPS and Raman. Platinum, Ruthenium, and Molybdenum deposition has been done by (1) cyclic voltammetry in metal solution at 50 mV/s doing a potential sweep between 0 V and 1.5 V. Various catalyst composites, incluiding, Pt/Ru, Pt/Ru, Pt/Ru/Mo on polycrystalline boron-doped diamond will be tested for methanol oxidation. The modified diamond surfaces will be characterized by SEM/EDS, XPS, and AFM.

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[i] Chrzanowski, W.; Kim, H.; Wieckowski, A. *Catal. Lett.* **1998** *50* 69-75.

[ii] Lin, W. F.; Zei, M. S.; Eiswirth, M.; Ertl, G; *J. Phys. Chem.* **1999** *103* 6968-6977.

[iii] Kevin, L.; Liu, R. X.; Pu, C.; Fan, Q.; Leyarovska, N.; Segre, C.; Smotkin E. S; *J. Electrochem. Soc.* **1997** *144* 1543.

[iv] E. Reddington; A. Sapienza, B; Gurau, R; Viswanathan, S; Sarangapani; E. S. Smotkin; T.E. Mallouk, *Science* **1998** *282* 1735.

[v] Zhang, H.; Wang, Y.; Fachini, E. R.; Cabrera, C. R. *Electrochem. Solid-State Lett.* **1999** 2 *9* 437-439.

[vi] Zhang Y.; Asahina S.; Yoshihara S.; Shirakashi, T. *Electrochim. Acta* **2003** *48* 741